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Terminal Delivery Control Tower

**A readiness-based PMO model for
greenfield terminal delivery**

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Foreword : From Works Progress to Readiness

Convergence

01

Terminal delivery must evolve from infrastructure completion to integrated launch readiness.



Greenfield container terminal projects are no longer pure construction programs.

They are integrated launch programs that combine marine infrastructure, heavy equipment, power systems, TOS and digital platforms, workforce ramp-up, safety and security approvals, lender conditions, concession obligations and commercial readiness. Their complexity does not only come from the number of tasks; it comes from the

number of dependencies that must converge at exactly the right time.

The industry often measures delivery through familiar workstream indicators: civil works progress, equipment manufacturing status, IT deployment progress, recruitment levels or procurement completion. These indicators remain important, but they are insufficient. They show whether activities are moving; they do not prove whether the terminal can safely and legally operate on day one.

“ The question for sponsors is no longer : are the works progressing ? The real question is: will the terminal be ready to operate safely, legally, digitally and efficiently on day one ? ”

This white paper argues for a readiness-based PMO model. The central idea is simple : a terminal does not go live because construction is complete; it goes live when infrastructure, equipment, systems, people, contracts,

authorities, lenders and operations converge into one controlled launch. This is the new role of the PMO : to operate as a Terminal Delivery Control Tower, with full visibility across dependencies, decisions, risks and readiness gates.

Container terminals are strategic assets, but the market context is more volatile and unforgiving

■ Global Scale and Volatility



In 2024, ports worldwide handled 920 million TEU, growing 6.9 percent year-on-year. This confirms the strategic relevance of terminal capacity investments and the continued expansion of containerized logistics networks. At the same

time, the maritime environment is not linear. Global maritime trade grew 2.2 percent in 2024, but the 2025 outlook points to slower growth of 0.5 percent, with containerized trade forecast at 1.4 percent. Terminal sponsors must therefore protect the value of capacity investments through stronger delivery discipline.

■ By the numbers

\$176→347bn

Global port construction market, 2025 to 2035

+64M TEU

Capacity added in 2025 alone, the largest jump since 2009

~400

Greenfield and multi-purpose terminal projects in the global pipeline

585M TEU

Additional capacity from 269 projects due 2024 to 2028

The scale of capital at stake reflects this urgency. The global port construction market is valued **at USD 176 billion in 2025 and is projected to nearly double to USD 347 billion by 2035**, a trajectory that underscores the rising importance of modern, scalable and technologically advanced port infrastructure in supporting international commerce (Astute Analytica, 2026). **Port infrastructure investment is also expected to grow from USD 63 billion in 2024 to USD 97 billion by 2040, making ports one of the fastest-scaling infrastructure subsectors globally** (PwC Global Infrastructure Outlook).

Capacity additions are accelerating alongside this investment. Global container handling capacity is projected to grow **by 64 million TEU in 2025 alone**, the largest absolute annual increase

since the global financial crisis, driven by the congestion-triggered investment wave of the post-pandemic period (Drewry, 2025). **Approximately 400 container and multi-purpose terminal projects are currently identified in global development pipelines** (DS Research, 2026), **of which 269 projects are scheduled for completion between 2024 and 2028**. Together, these projects represent 585 million TEU of additional capacity, a pipeline that will only deliver its intended value if projects are launched with operational discipline.

The issue is not only market demand. It is also competitive timing. A terminal that is physically complete but operationally unready cannot capture volumes, serve customers or generate expected returns. Launch delays can weaken

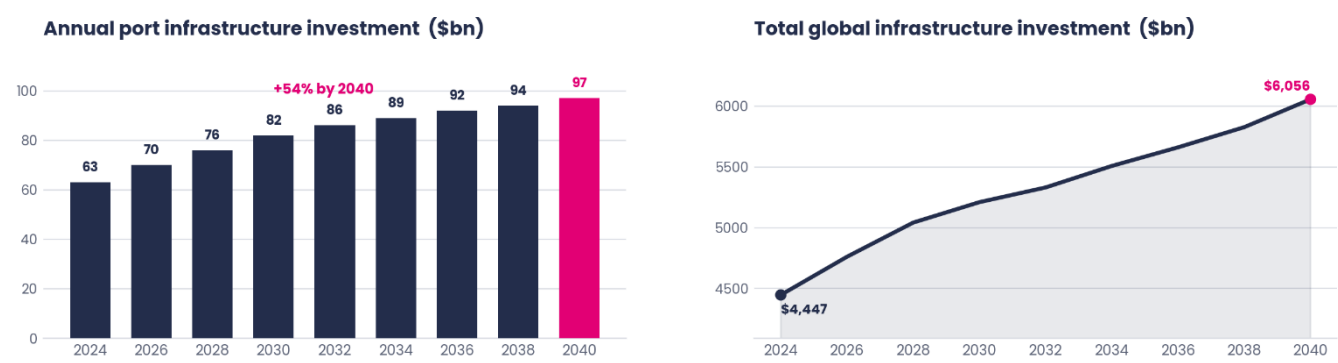
concession credibility, postpone revenue, create claims exposure, disrupt shipping-line commitments and force temporary workarounds that become expensive to unwind.

Sources : Astute Analytica Port Construction Market Report 2026; PwC Global Infrastructure Outlook; Drewry press release, 22 Sep 2025; DS Research 2026 & 2024

TABLE 1 : PORT INFRASTRUCTURE INVESTMENT OUTLOOK TO 2040

Year	Roads & Bridges (\$bn)	Rail (\$bn)	Airports (\$bn)	Ports (\$bn)	Global Total (\$bn)
2024	\$846	\$369	\$80	\$63	\$4,447
2026	\$902	\$400	\$82	\$70	\$4,761
2028	\$958	\$436	\$91	\$76	\$5,042
2030	\$1,017	\$466	\$98	\$82	\$5,210
2032	\$1,068	\$490	\$103	\$86	\$5,331
2034	\$1,113	\$511	\$109	\$89	\$5,508
2036	\$1,158	\$532	\$114	\$92	\$5,661
2038	\$1,200	\$553	\$120	\$94	\$5,827
2040	\$1,242	\$573	\$126	\$97	\$6,056

Source : PwC Global Infrastructure Outlook (ports column highlighted). Full dataset covers all transport subsectors.



Port-sector investment rises steadily through 2040 within a broader infrastructure market approaching USD 6 trillion.

Source : PwC Global Infrastructure Outlook ; values in USD billions.

■ Rising Complexity



Modern greenfield terminals must manage larger vessels, deeper drafts, higher productivity expectations, complex STS and yard equipment, advanced TOS platforms, digital gate systems, cybersecurity, power and electrification requirements, environmental obligations, financing conditions and strict safety/security compliance. Each driver adds tasks, but more importantly it multiplies the number of interfaces that can block launch.

This complexity is no longer confined to individual projects. Greenfield developments are regaining traction globally, particularly in emerging markets. Currently, **14 global terminal operators (GTOs) include one or more greenfield projects in their development pipelines, and four operators** (CMA CGM, Adani, MSC and AD Ports) are each projected to add at least 3 millions TEU

of greenfield capacity by 2029, with Vietnam, Egypt, India and Morocco as priority investment destinations (Drewry, 2025).

While brownfield projects continue to dominate overall market share at 60.8 percent due to lower startup costs, the greenfield pipeline is where delivery risk is highest, startup costs are 20 to 40 percent greater, and the consequences of readiness failures are most acute.

For these operators and their project sponsors, the readiness gap is not a theoretical concern. It is a structural exposure that must be managed as deliberately as the construction program itself.

Sources : Drewry Global Terminal Operators Report, Sep 2025; Astute Analytica Port Construction Market Report 2026; DS Research 2026

Completion statistics can hide launch-critical gaps

■ The Project-Control Gap

Traditional progress reporting is organized by workstream. It can show that civil works are advanced, equipment is manufactured, IT systems are configured, staff are recruited and contracts are signed. But it may still miss the central launch question : can the terminal operate safely, legally and efficiently when the go-live date arrives ?

This gap is not theoretical. Large capital programs remain structurally exposed to overruns. McKinsey's 2025 review of more than 300 billion-dollar-plus megaprojects found **average cost overruns of approximately 80 percent and schedule delays of about 50**

Percent. For terminal projects, a major source of this exposure is late discovery of unresolved dependencies between infrastructure, equipment, systems, legal readiness, authority approvals and operations.

The greenfield context compounds this exposure. Unlike brownfield upgrades which typically require 20 to 40 percent lower startup costs and fewer early-stage barriers, greenfield terminals carry full delivery risk from a blank slate. With 269 projects scheduled for completion between 2024 and 2028 and 585 millions TEU of capacity at stake globally, the systemic cost of poor readiness management across the industry is substantial.

« Performance outcomes in megaprojects characterized by ~80% cost overruns and ~50% schedule delays are not the result of isolated workstream failures, but of misaligned and coevolving governance and contractual mechanisms »

■ Readiness Changes the Questions

A readiness-based PMO does not replace traditional project control. It strengthens it. It links workstream progress to operational consequences and asks whether each prerequisite is evidenced. Instead of accepting that equipment is delivered, it verifies whether

marine access, quay readiness, power, insurance, warranty, OEM teams, surveyors, trained operators and maintenance capacity are in place. Instead of accepting that the TOS is configured, it verifies whether customs, ERP, billing, gate, yard and reporting flows have been tested end-to-end.

The Rule of 1: A terminal is only as ready as its least mature critical dependency

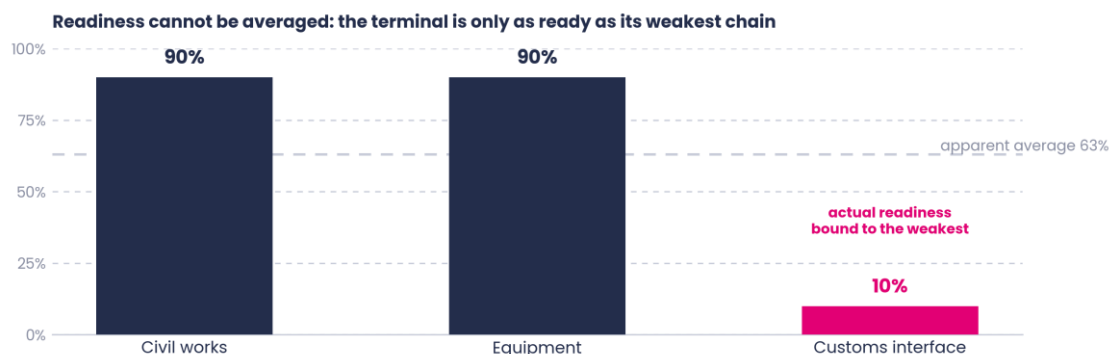
■ Visible Path Versus Hidden Path

The visible critical path is usually construction-driven: quay works, yard pavement, buildings, utilities, equipment delivery and systems implementation. The hidden critical path is readiness driven. It appears at the interfaces between workstreams, where ownership is less clear and consequences are often underestimated until final launch preparation.

A site handover delay can block contractor access, lender evidence, environmental

compliance and the baseline schedule. A dredging delay can prevent equipment arrival or first vessel access. Crane rail deviations can stop STS commissioning. Lack of temporary power can freeze equipment testing. Missing telecom approval can delay radio or Wi-Fi deployment. An untested customs interface can block gate and cargo flow. An insurance gap can expose the operator during commissioning. These are not side issues ; they are launch-critical dependencies.

« You cannot average out readiness. A terminal that is 90% ready on civil works, 90% on equipment, and 10% on customs interface is not 63% ready, it is 0% ready. The readiness of the entire terminal is bound by the slowest chain in the system »



Illustrative : a terminal that is 90 percent ready on two chains but 10 percent on a third is not 63 percent ready; overall readiness is bound to the least mature chain.

■ Why It Is Discovered Late

Hidden critical path items are often embedded inside individual workstreams and therefore reported as local issues. The PMO must surface

them as cross-domain risks. The right question is not simply who owns the task, but which readiness chain can block and what the schedule, cost, legal, financing or go-live consequence would be if it remains open.

TABLE 2 : HIDDEN BLOCKERS AND POTENTIAL PROJECT CONSEQUENCES

Hidden blocker	Potential consequence
Site handover or soil issue	Delayed works, lender CP exposure, cost increase
Dredging or marine access	Equipment arrival or first vessel constraints
Power availability	STS/RTG commissioning delay
TOS/customs interface	Gate, clearance and billing disruption
Insurance or warranty ambiguity	Asset-risk exposure during tests
Training or certification gap	Unstable first-vessel operations

The PMO must become the operating system of readiness convergence

■ Beyond Reporting

A reporting PMO consolidates status. A control-tower PMO creates project intelligence. It connects the master schedule, workstream progress, risks, issues, decisions, interfaces, authority approvals, lender requirements and go-live gates into one integrated view. This is especially important in terminal projects because every domain has only a partial view of the system.

Infrastructure teams see work and handovers. Equipment teams see manufacturing, shipping and commissioning. IT teams see systems and interfaces. HR sees recruitment, contracts and training. Legal sees warranties, liability and claims. Finance sees drawdowns, budget and business plan impacts. Operations see SOPs, shift coverage and first-vessel readiness. The PMO must translate these views into one question : is terminal readiness converging ?

« A Control Tower PMO is not a repository for status reports ; it is an engine for decision-making. If a decision on power, insurance, or TOS interfaces remains unresolved, the launch sequence is not green, it is blocked. We track decision ageing to ensure the project never stalls on administrative indecision »

■ Evidence-Based Governance

The control tower must also change the quality of governance conversations. Committees should not only review what happened last week ; they should focus on the decisions and evidence required to keep launch viable.

A decision delayed by four weeks on power, insurance, TOS interfaces or civil defense may have a greater impact than a visible delay in a local construction activity. The control tower must make this impact explicit.

TABLE 3 : CONTROL TOWER COMPONENTS AND FUNCTIONS

Component	Function
Integrated Master Schedule	Controls timeline and critical readiness chain
Readiness Dashboard	Tracks launch conditions by evidence, not opinion
Interface Register	Controls dependencies between workstreams
Risk / Issue / Action Logs	Transforms uncertainty and blockers into managed actions
Decision Log	Tracks required decisions, ageing and impact of delay
Authority / CP Tracker	Controls permits, lenders, regulators and external evidence
Go-Live Reverse Plan	Works backward from launch to protect final convergence

The PMO must become the operating system of readiness convergence

■ **Site, Infrastructure and Marine Readiness**

Site readiness is broader than land availability. A terminal site should be considered ready only when legal handover, technical survey, geotechnical baseline, environmental conditions, contractor access, temporary facilities, utilities, dredging and marine approach assumptions are sufficiently controlled. If this gate is weak, downstream planning becomes unstable and claims exposure increases.

Marine readiness is equally critical. The terminal must physically receive equipment and vessels. Dredging, basin depth, approach channel constraints, navigation aids, quay readiness, crane rails and mooring assumptions must be treated as one chain, not as disconnected technical items. This is particularly important for STS arrival, first-vessel planning and future berth productivity.

TABLE 4 : SITE AND MARINE CONTROL MEASURES AND PURPOSES

Site/Marine Control	Purpose
Site handover gate	Secure legal and technical baseline
Soil and contamination assessment	Avoid late remediation and lender-compliance risk
Dredging tracker	Secure vessel and equipment access
Quay and rail readiness	Enable crane delivery and commissioning
Utility and firefighting readiness	Support commissioning and safety approval

■ **Equipment Arrival and Commissioning**

Equipment readiness is not achieved when equipment is manufactured or delivered. STS cranes, RTGs, eRTGs, tractors, trailers, spreaders and maintenance assets become operational only when they can be received, powered, insured, tested, accepted, operated and maintained. This requires a formal Equipment Arrival Passport and Commissioning Passport for each major equipment family.

Equipment arrival is not the finish line ; it is the start of the commissioning phase. A crane on the quay is a capital asset, but it is not yet an operational tool. It only becomes productive when it is powered, integrated with the TOS, tested, insured, and handed over to trained operators. Failing to treat commissioning as a disciplined, evidence-based sequence creates a 'commissioning trap' where assets are physically present but operationally inert, delaying revenue realization and eroding customer confidence.

TABLE 5 : PASSPORT ITEMS AND SIGNIFICANCE

Passport Item	Why it matters
Marine access and quay/rail readiness	Enables safe unloading, positioning and movement
Power availability	Enables commissioning and test sequences
Insurance and warranty trigger	Protects asset risk and commercial exposure
OEM, surveyor and operators	Secures acceptance, training and operational handover

The terminal operating model depends on digital, human and process readiness.

■ IT/TOS and Digital Integration

The TOS is not a software installation. It is the operating backbone of the terminal. It connects vessel planning, yard planning, gate operations, equipment dispatch, customs, ERP, billing, reporting and customer service. IT readiness is therefore achieved only when operational scenarios are tested end-to-end, users are trained, interfaces are validated and hyper-care is mobilized.

Large IT projects remain exposed to execution risk. McKinsey/Oxford research found that large IT projects run on **average 45 percent over budget, 7 percent over time and deliver 56 percent less value than expected**. In a terminal context, the consequence is not only IT cost; it is operational instability. A failed interface can block customs clearance, gate flow, invoicing or yard execution.

« The industry standard for large IT implementations is marked by a dual erosion : 45% of the budget is consumed by overruns, while 56% of expected value is never realized. To avoid this outcome, readiness must be managed as a convergence, not a series of isolated workstreams »

■ HR, Training and Operational Readiness

People's readiness is not recruitment. It is the ability to operate by shift, by process and by scenario. A terminal may have the required headcount and still be operationally unready if planners, crane operators, yard teams, maintenance, gate staff, HSSE and supervisors are not trained, certified and scheduled against realistic operating scenarios.

Operational readiness should start months before technical completion. It includes the target operating model, organization structure, SOP library, training curriculum, safety and emergency procedures, shift coverage, dry runs, first-vessel plan and post-go-live command center. These deliverables must be tracked with the same discipline as civil works and equipment commissioning.

TABLE 6 : DIGITAL SYSTEMS READINESS : VALIDATION AND COMPLIANCE CRITERIA

Digital component	Readiness evidence
TOS core	Configuration and key business rules tested
Customs / ERP / billing	End-to-end data exchange validated
Gate and yard systems	OCR, access, Wi-Fi, DGPS, VMT/RDT tested
Hypercare	Support team and escalation model mobilized

External and contractual readiness can shape the launch path as much as contractors do

■ Legal, Insurance and Contractual Readiness

Legal readiness is not back-office support. It protects commissioning, acceptance, asset risk and operational launch. Equipment damage insurance, third-party liability, warranty trigger dates, acceptance conditions, force majeure

notices, claims management, handover protocols and contractor interfaces should be treated as go-live enablers. Without this control, the project may technically move forward while exposing the operator to uninsured or disputed risk.

TABLE 7 : LEGAL AND CONTRACTUAL RISK OVERSIGHT CHECKLIST

Legal topic	Control question
Insurance	Are assets covered before and during commissioning ?
Warranty	When does the warranty start and under what conditions ?
Acceptance	What proves acceptance and what remains reserved?
Liability	Who carries risk during handover and testing?
Claims	Is the process defined, evidenced and owned?
Concession	Are obligations mapped and tracked to evidence?

■ Authority, Financing and Business Plan Readiness

Greenfield terminals depend on external stakeholders : port authorities, customs, telecom regulators, civil defense, security agencies, lenders, shareholders and commercial partners. These interfaces should not be chased at the end. They should be managed as project-critical deliverables with owners, due dates, evidence requirements and escalation thresholds.

Financing conditions precedent can become a real critical path because evidence often depends on technical, legal, environmental and authority deliverables. The business plan must also remain connected to project reality. Any go-live delay, CAPEX variation, equipment delay, ramp-up shift or commercial assumption

change should trigger an assessment of revenue timing, cash needs and shareholder exposure.

The stakes of getting this wrong are amplified by the scale of investment now committed to the sector. With port infrastructure capital

expenditure on a trajectory from USD 63 billion in 2024 toward USD 97 billion by 2040, and with major operators individually committing to multi-billion-dollar greenfield pipelines, lender and shareholder scrutiny of delivery readiness has never been more intense.

TABLE 8 : EXTERNAL STAKEHOLDER MANAGEMENT AND REGULATORY REQUIREMENTS

External Area	Control Required
Port authority	Site, dredging, vessel entry and access
Customs	Clearance process and system interface
Telecom / radio	Wi-Fi, radio and hardware approvals
Civil defense / ISPS	Firefighting, safety and security certification
Lenders / shareholders	CP evidence, capital, business plan and governance

The model should end when the terminal is stabilized after go-live, not when construction is complete

■ The 15-Gate Delivery Model

The proposed delivery model creates a disciplined path from concession and governance to ramp-up REX. Each gate should have a clear owner, due date, required evidence,

residual risk position and go/no-go decision rule. This makes the model practical: it converts complexity into a sequence of evidence-based decision points rather than a set of disconnected status updates.

01 Secure	Concession & governance • Financing / CPs • Scope freeze • Contracting
02 Build	Site handover • Infrastructure • Authority & permits • Equipment manufacturing
03 Activate	Equipment arrival • Commissioning • IT / TOS • HR & training
04 Launch & Stabilize	Operational readiness • Go / No-Go • Ramp-up REX

The 15-Gate model groups the delivery sequence into four readiness phases, from concession to post go-live stabilization.

■ How the Gates Should Be Used

A gate is not a meeting. It is an evidence-based decision point. Green status should only be granted when the expected evidence exists: signed handover certificates, validated surveys, approved procedures, tested interfaces, active insurance, confirmed permits, certified teams, completed dry runs or accepted commissioning reports. Amber means that readiness is achievable but exposed. Red means that launch

conditions are not satisfied and executive action is required.

■ PMO Toolkit and KPI Cockpit

A readiness-based PMO requires a practical toolkit: Integrated Master Schedule, readiness dashboard, interface register, risk register, issue log, action tracker, decision log, authority tracker, CP tracker, equipment passport, IT/TOS matrix, HR ramp-up matrix, legal gate checklist, go-live reverse schedule and hypercare dashboard.

The KPI cockpit should cover decision ageing, overdue actions, open critical risks, readiness by chain, commissioning defects, interface test

success, staffing, training, dry runs, first-vessel readiness and ramp-up performance.

TABLE 9 : PROJECT PERFORMANCE MONITORING: STRATEGIC KPI FRAMEWORK

KPI family	Example indicators
Governance	Decision ageing, overdue actions, escalation rate
Schedule / risk	Critical milestones, open critical risks, mitigation closure
Readiness	% readiness by chain and gate status
Equipment / IT	Commissioning completion, defects, interface tests
HR / operations	Staffing, training, certification, dry-run completion
Ramp-up	Crane productivity, berth productivity, truck turnaround time

■ Executive Recommendations

Sponsors should start with a readiness-based PMO design, build the project around dependencies rather than workstreams, treat site handover, equipment arrival, IT/TOS, HR, legal and authority approvals as formal gates, use reverse scheduling before go-live, quantify delay/cost/risk/business plan impacts and extend PMO control beyond construction completion into ramp-up.

The final REX cycle should be structured at 30, 60 and 90 days. The first cycle stabilizes incidents and validates hyper-care. The second cycle measures operational performance and fixes structural pain points. The third cycle converts

lessons into reusable methods, templates, gates and decision rules for the next terminal project.

The industry is at an inflection point. With approximately 400 greenfield and multi-purpose terminal projects in development globally, 585 million TEU of capacity in the pipeline, and port construction investment projected to nearly double over the next decade, the discipline of terminal delivery has never been more consequential. The PMO that operates as a Terminal Delivery Control Tower tracking readiness chain, not just workstream completion will be the decisive factor between a terminal that opens on time, in control, and one that arrives at go-live still resolving the dependencies it should have closed months earlier.

« The future of greenfield terminal delivery will belong to sponsors who manage readiness convergence, not only construction progress. »

About the Author



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This white paper sets out a readiness-based PMO model for greenfield terminal delivery: a Terminal Delivery Control Tower that governs convergence across infrastructure, equipment, systems, people, contracts, authorities and financing, so that a terminal opens in control rather than arriving at go-live still resolving dependencies that should have closed months earlier

Transforming Complexity into Impact : The Inetum Consulting Approach

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